

# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : **MITSUBISHI MATERIALS CORP**

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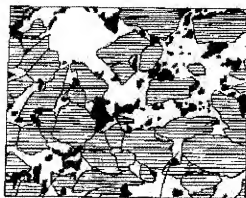
(72)Inventor : **YAMAMOTO KAZUO**

## **(54) CUTTING TOOL MADE OF CUBIC BORON NITRIDE SUPER HIGH PRESSURE SINTERED MATERIAL EXCELLENT IN WEAR RESISTANCE**

(57)Abstract:

PURPOSE: To provide a cutting tool made of cubic boron nitride super high pressure sintered material to demonstrate the excellent wear resistance in the high speed cutting.

CONSTITUTION: A cutting tool made of cubic boron nitride super high pressure sintered material has the composition consisting of, by volume, 20-40% Ti carbide consisting of one or two or more kinds of Ti carbide, Ti nitride and Ti carbon-nitride, 1-5% aluminium nitride, 3-7% titanium boride, 3-15% aluminium oxide, and the balance cubic boron nitride with inevitable impurities, and contains the structure where at least 60% in area of the cubic boron nitride grains is mutually bonded in the face analysis by the scan type Auger electron microscope



$Al_2O_3$

CBN

$TiN+AlN+TiB_2$

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### CLAIMS

[Claim 1] Cutting tools made of cubic boron nitride-based super high pressure sintered material with superior wear resistance that has the following composition by volume:

20-40 vol.% of Ti carbide/nitride consisting of one or more materials selected from Ti carbide, Ti nitride and Ti carbide-nitride,

1-5 vol.% of aluminium nitride,

3-10 vol.% of Ti boride,

3-15 vol.% of aluminium oxide and

the residual consisting of cubic boron nitride and included impurities,

and has at least 60% of the area of the boron nitride grains mutually bonded, as observed in surface analysis through Auger scanning electron microscopy.

### DETAILED DESCRIPTION

[0001]

[Industrial Application] Especially this invention relates to the cutting tool made from a cubic-boron-nitride (CBN) shows hereafter) machine extra-high voltage sintered material which demonstrates the abrasion resistance which was excellent when it used for high speed cutting, such as cast iron and steel.

[0002]

[Description of the Prior Art] Conventionally, generally, so that it may be indicated by JP,59-27303,A As a binder-phase formation component, the carbide, nitride, and charcoal nitride of Ti Ti charcoal and the nitride which consists of one sort

in (TiC, TiN, and TiCN show hereafter, respectively), or two sorts or more : 20 - 40% is contained. It is also known that the cutting tool which consisted of CBN machine extra-high voltage sintered materials which have the composition (capacity % and following % show capacity % above) which the remainder becomes from CBN and the unescapable impurity as a dispersed phase formation component is known, and this is used for cutting of cast iron, steel, etc.

[0003]

[Problem(s) to be Solved by the Invention] On the other hand, in the above-mentioned cutting tool made from a conventional CBN machine extra-high voltage sintered material, although highly-efficient-izing of a cutting machine in recent years is remarkable and a cutting speed is in the inclination of improvement in the speed conjointly with labor-saving, if high speed cutting is performed using this, wear advance will be very quick and will result in a use life comparatively for a short time.

[0004]

[Means for Solving the Problem] Then, the result which inquired that this invention person etc. should solve the trouble which the above-mentioned cutting tool made from a conventional CBN machine extra-high voltage sintered material has from the above viewpoints, A cutting tool by capacity % (% shows capacity % below), TiC, TiN, From one sort in TiCN, or two sorts or more to and Ti charcoal and a nitride : 20 - 40%, Aluminium nitride (AlN shows hereafter) : 1 - 5%, boronizing titanium : 3 - 10%, an aluminum oxide (TiB<sub>2</sub> shows hereafter) : The composition which 3 - 15% is contained and the remainder becomes from CBN and an unescapable impurity, (aluminum 2O<sub>3</sub> shows hereafter) And if constituted from a CBN machine extra-high voltage sintered material which has the organization of the CBN grains where 60 area % carried out cross coupling at least by the field analysis under a scanned type Auger electron microscope The cutting tool made from a CBN machine extra-high voltage sintered material of this result showed the abrasion resistance which was excellent even if it used this for high speed cutting, and obtained the research result of coming to demonstrate the cutting-ability ability which continued and was excellent in the long period of time.

[0005] This invention is made based on the above-mentioned research result, and explains the reason which limited component composition of the CBN machine extra-high voltage sintered material which constitutes a cutting tool as above-mentioned.

(a) Ti charcoal and a nitride, although the component of these has the operation which raises intensity and toughness The effect of a request [ at less than 20% ] of the content to the aforementioned operation is not acquired, but, as a result, become easy to generate a chip and a chipping (minute chip) in a cutting edge on the occasion of cutting. Since abrasion resistance came to have fallen rapidly on the other hand when the content exceeded 40%, the content was desirably determined as 30 - 35% 20 to 40%.

[0006] (b) Contribute to these components on a sintering disposition. AlN and TiB<sub>2</sub> -- It is a component indispensable to one step of improvement in on the strength, therefore either of these components is also less than [ AlN:1% ] and TiB<sub>2</sub> : At less than 3%, the improvement in on the strength of a request cannot be aimed at. on the other hand -- either of these components -- AlN:5% and TiB<sub>2</sub> : the content if 10% is exceeded, since abrasion resistance will come to fall rapidly -- respectively -- AlN:1-5% -- desirable -- 2 - 4%, and TiB<sub>2</sub> : It was desirably determined as 4 - 7% 3 to 10%.

[0007] (c) aluminum 2O<sub>3</sub>aluminum 2O<sub>3</sub> Although especially the component had the operation which suppresses the plastic deformation to the high temperature generated in high speed cutting, the effect of a request [ at less than 3% ] of the content to the aforementioned operation was not acquired, but when the content exceeded 15% on the other hand, the content was desirably set that a fall inclination appears with 7 - 12% to intensity 3 to 15% from the bird clapper.

[0008] In addition, in the cutting tool of this invention, although it has the organization where more than 60 area % of a CBN grain carried out cross coupling as above-mentioned, this cross coupling rate cannot secure the abrasion resistance which was excellent in the request by the cross coupling rate being under 60 area % based on an experimental result.

[0009]

[Example] Below, an example explains concretely the cutting tool made from a CBN machine extra-high voltage sintered material of this invention. The CBN powder which has a mean particle diameter within the limits of 1-3.5 micrometers as raw material powder, The TiC powder which similarly has a mean particle diameter within the limits of 0.5-1.8 micrometers, TiN powder and TiCN powder, AlN powder, and TiB<sub>2</sub> Powder and aluminum 2O<sub>3</sub> Powder is prepared. Blend these raw material powder with the combination composition shown in Tables 1 and 2, and a rotation ball mill performs wet blending of 72 hours. After dryness and 3 ton/cm<sup>2</sup> Press forming is carried out to the green compact which is a pressure and had a diameter:20mm thickness:1.5mm size. The temporary-quenching join of this green compact is carried out to the predetermined temperature in the vacuum of 3x10<sup>-4</sup>torr, and within the limits of 1000-1300 degrees C on condition that maintenance for 30 minutes. It inserts in extra-high voltage sintering equipment in the state where it piled up with WC basis cemented carbide base material which continued and had a diameter:20mm thickness:2mm size. Pressure : Extra-high voltage sintering is carried out on condition that maintenance for 30 minutes by 5GPa at the predetermined temperature within the limits of 1200-1400 degrees C. Carry out the grinding of the vertical side,

quadriseet by wire cut, and it solders to the base metal made from WC basis cemented carbide. The cutting tool made from this invention CBN machine extra-high voltage sintered material which had the same component composition as combination composition in the predetermined throwaway tip configuration substantially by carrying out polish finishing (It is hereafter called this invention cutting tool) The cutting tools 1-7 made from a CBN machine extra-high voltage sintered material (conventionally henceforth a cutting tool) were manufactured 1-15, and conventionally, respectively. In addition, the copy view showed the observation organization under the scanned type Auger electron microscope of this invention cutting tool 2 to drawing 1.

[0010] this invention cutting tools 1-15 obtained as a result and conventionally subsequently, about cutting tools 1-7 \*-ed material : The round bar of FCD70 (spheroidal graphite cast iron), cutting-speed:400m/min., It sends 0.35mm. Infeed : 0.15mm/rev., time:20 minutes. The wet continuation high-speed-cutting examination of the cast iron in \*\*\*\*\*, and the carburization hardening round bar of \*-ed material:SCN415, cutting-speed: -- 200m/min. -- cutting deeply -- : -- 0.1mm, it sent, the dry type continuation high-speed-cutting examination of the steel in the conditions of 0.1mm/rev. and time:20-minute \*\* was performed, and any examination measured the width of flank wear land of a cutting edge These measurement results were shown in Tables 1 and 2.

[0011]

(Table 1)

圖 別	配 合 組 成 (質量%)							溝け面摩耗量 (mm)		
	TiC	TiN	TiCN	AlN	TiB <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CBN	溝 底	側 面	
本 発 明 の 切 削 工 具	1	32	-	-	3	5	10	残	0.15	0.22
	2	-	32	-	3	5	10	残	0.18	0.21
	3	-	-	32	3	5	10	残	0.18	0.22
	4	16	16	-	3	5	10	残	0.18	0.19
	5	25	-	5	3	5	10	残	0.19	0.18
	6	-	10	10	3	5	10	残	0.27	0.15
	7	10	10	20	3	5	10	残	0.29	0.12
	8	20	12	-	3	5	10	残	0.20	0.18
	9	35	-	-	3	5	10	残	0.29	0.13
	10	-	25	5	1	5	10	残	0.19	0.16
	11	18	5	5	5	5	10	残	0.24	0.16

[0012]

(Table 2)

圖 別	配 合 組 成 (質量%)							溝け面摩耗量 (mm)		
	TiC	TiN	TiCN	AlN	TiB <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	CBN	溝 底	側 面	
本 発 明 の 切 削 工 具	12	10	20	5	3	10	残	0.25	0.15	
	13	5	20	10	3	7	10	残	0.28	0.10
	14	-	32	-	3	5	3	残	0.27	0.10
	15	-	-	32	3	5	15	残	0.20	0.11
従 来 の 切 削 工 具	1	32	-	-	-	-	-	残	0.58	0.54
	2	-	32	-	-	-	-	残	0.62	0.52
	3	-	-	32	-	-	-	残	0.49	0.51
	4	16	16	-	-	-	-	残	0.50	0.51
	5	27	-	5	-	-	-	残	0.55	0.56
	6	-	15	10	-	-	-	残	0.67	0.50
	7	10	10	20	-	-	-	残	0.67	0.50

[0013]

[Effect of the Invention] It is clear from the result shown in Tables 1 and 2 that this invention cutting tools' 1-15 the abrasion resistance which was conventionally excellent in high speed cutting as compared with cutting tools 1-7 is shown. As mentioned above, not to mention the usual cutting, the cutting tool made from a CBN machine extra-high voltage sintered material of this invention shows the abrasion resistance which is especially high speed cutting and was excellent, and demonstrates the cutting-ability ability which continued and was excellent in the long period of time.